Development of Double-Controlled Drug Eluting Stents with Nanotechnology

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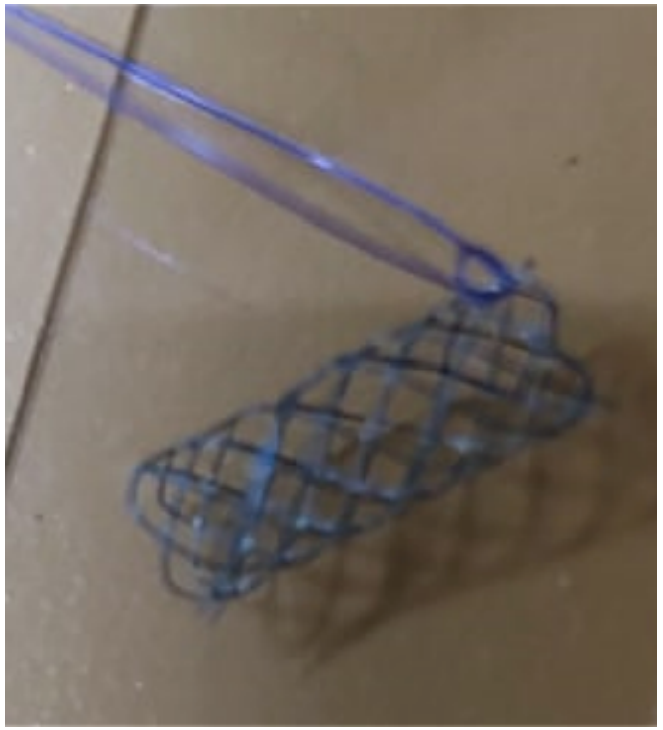
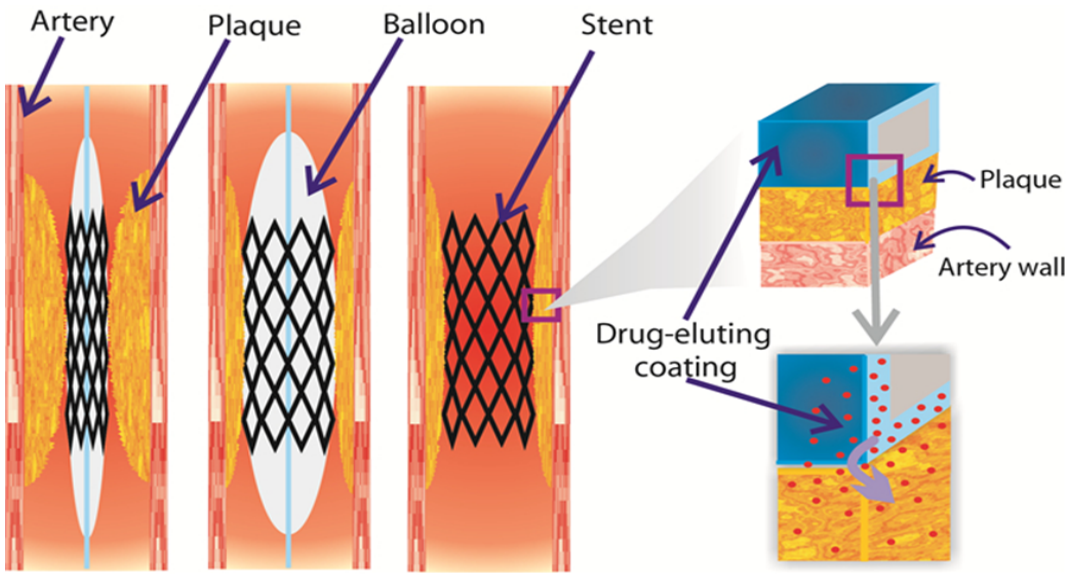
Stent Project

Description

- Used for drug delivering
- Consists of three parts
  - Stent platform
  - A polymer coating that binds the drug to the stent and releases the drug
  - Drug



Drug-Eluting Stent (DES)



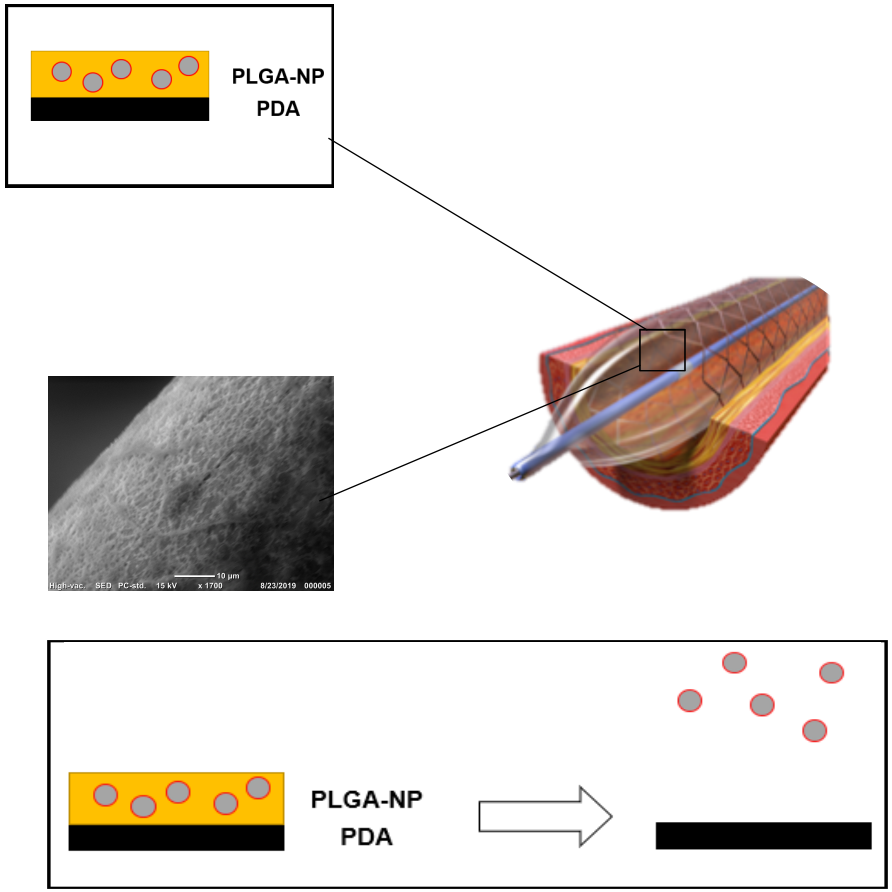
- Coated with medication that is slowly released to help prevent the growth of scar tissue in the artery lining
- Reduces the need for repeat angioplasty procedures
- Drug-eluting stents are more likely to keep the blockage from the recurring compared to bare metal stents
- Although DES was proved to be a safe and effective method in treatment of coronary artery stenosis by real world practices, there are still ongoing trials under evaluation for other subsets

Purpose

The aim for this research is to use a non-vascular stent that encapsulates gemcitabine-loaded mesoporous silica nanoparticles (gMSNP) in polydopamine (PDA) and poly(lactic-co-glycolic) acid (PLGA) polymer matrix to advance the outcomes of drug release.

Methodology

Schematic



PDA Coating

1. Dopamine hydrochloride was dissolved in 5mM Tris buffer (pH 8.5) to form 1 mg/mL solution
2. Stent was immersed
3. Dopamine polymerization onto stent
4. Washed with water
5. Repeat 1-4 two additional times in same condition

PLGA Polymer Matrix Coating + Silica Nanoparticles (NP)

1. PLGA was dissolved in acetone
2. The PDA-coated stent was immersed in the PLGA solution and dried under room temperature
3. Repeat 1 and 2 two additional times in the same condition
4. Silica Nanoparticles were dispersed within the PLGA solution and coated onto the PDA-coated stent in the same manner

Drug Release Data

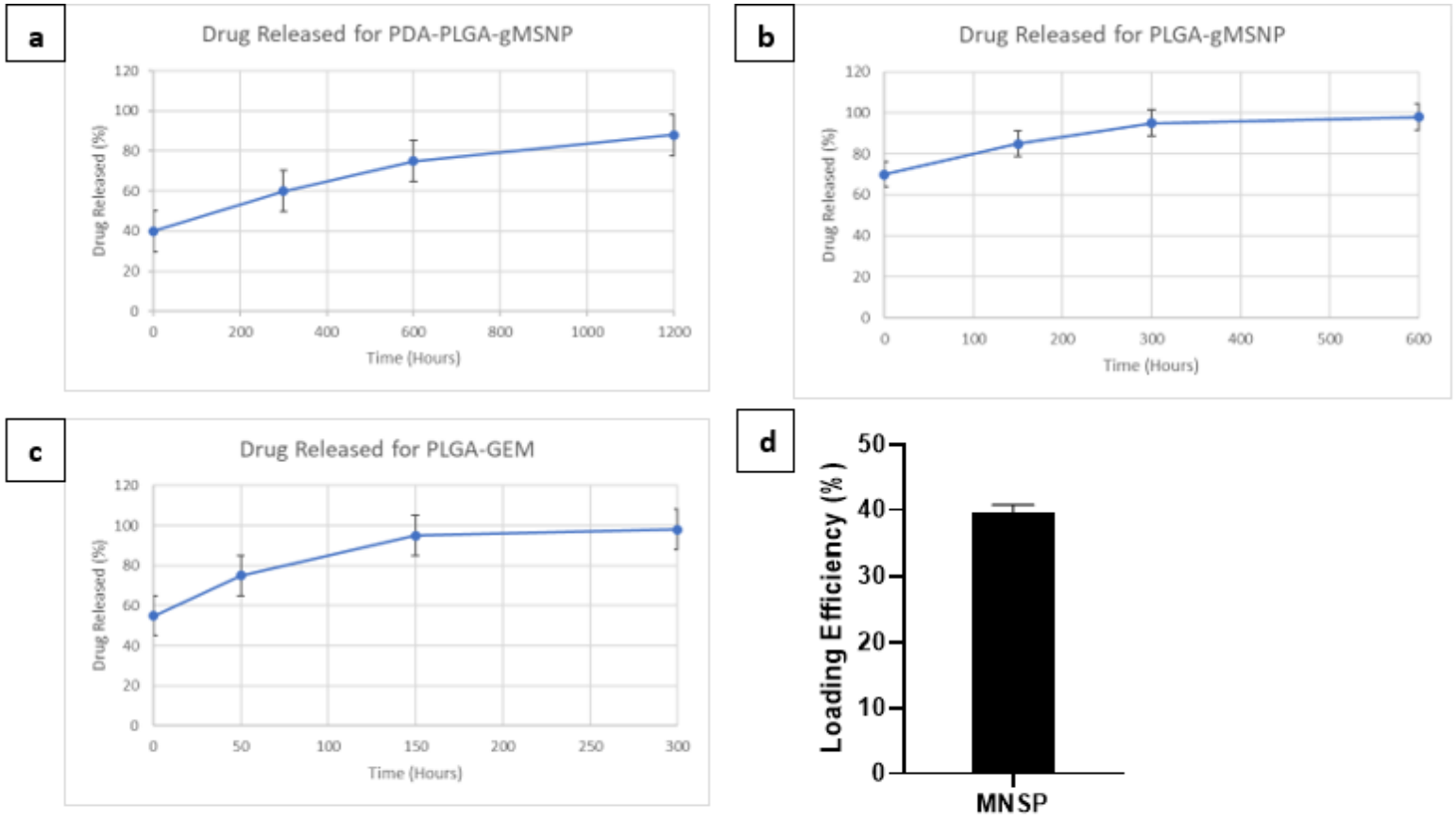


Figure. (a) Drug release profile of gMSNP with PDA-PLGA. (b) Drug release profile of gMSNP with PLGA coating. (c) Drug release profile of GEM with PLGA coating. (d) Loading efficiency of gemcitabine onto MSNPs.

Conclusion

The data for the drug release collected showed a smaller burst release followed by a near zero-order release for the DES, which shows a constant rate of drug release over time. At 2 weeks after the initial release, the DES had 40 percent less drug released than PLGA loaded with pure GEM precipitates ($p < 0.05$). The measured sustained drug release will eventually reduce the rate of restenosis that can be induced by stents.

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